

Sharing the reduction effort to limit global warming to 2°C

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In order to stabilize long-term greenhouse gas concentrations at 450 ppm CO₂-eq or lower, developed countries as a group should reduce emissions by 25–40% below 1990 levels by 2020, while developing countries' emissions need to be reduced by around 15–30%, relative to their baseline levels, according to the IPCC and our earlier work. This study examines 19 other studies on the emission reductions attributed to the developed and developing countries for meeting a 450 ppm target. These studies considered different allocation approaches, according to equity principles. The effect of the assumed global emissions cap in these studies is analysed. For developed countries, the original reduction range of 25–40% by 2020 is still within the average range of all studies, but does not cover it completely. Comparing the studies shows that assuming a global emissions cap of 5–15% above 1990 levels by 2020 generally leads to more stringent reduction targets than when a global emissions cap of 20–30% above 1990 levels is assumed. For developing countries, the reduction range of 15–30% below their baseline levels by 2020 corresponds to an increase on the 1990 level from 70% (about the 2006 level) to 120%. Reducing deforestation emissions by 50% below baseline levels by 2020 may relax the emission reductions for either group of countries; for developing countries by about 7% or for developed countries by about 15% (but not for both).

Keywords: CO₂ allowances; emission allowances; emission reductions; developed countries; developing countries

Une stabilisation à long terme des concentrations de gaz à effet de serre à 450ppm d'équivalent-CO₂ ou moins, nécessiterait, d'après le GIEC et nos travaux antérieurs, la réduction des émissions des pays développés réunis de 25 à 40% au-dessous du niveau de 1990 d'ici 2020, et d'environ 15 à 30% pour les pays en développement par rapport à leur niveau de référence. Cette étude examine 19 autres études portant sur les réductions d'émissions requises par les pays développés et les pays en développement pour atteindre l'objectif de 450ppm. Ces études ont examiné différentes méthodes d'allocation conformément aux principes d'équité. L'importance du plafond global d'émission présumé dans ces études est analysée. Pour les pays développés, l'écart initial de réduction de 25 à 40% d'ici 2020 est toujours compris dans l'écart moyen des études en question, mais ne le couvre pas entièrement. La comparaison des études montre que l'adoption d'un plafond global d'émissions de 5 à 15% au-dessus du niveau de 1990 d'ici 2020 nécessiterait en général des cibles de réduction plus rigoureuses que pour un plafond global d'émissions de 20 à 30% au-dessus du niveau de 1990. Pour les pays en développement, la fourchette de réduction de 15 à 30% au-dessous du niveau de référence d'ici 2020, correspond à une augmentation du niveau de 1990 allant de 70% (à peu près le niveau de 2006) à 120%. Une réduction de 50% des émissions dues à la déforestation, d'ici 2020, par rapport au niveau de référence, aurait un effet de relâche sur la contrainte de réduction dans chacun des deux groupements de pays, à savoir de l'ordre de 7% pour les pays en développement et de 15% pour les pays développés (mais pas les deux).

Mots clés: allocations de CO₂; allocations d'émissions; Nord-Sud; pays développés; pays en développement; réductions d'émissions

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1. Introduction

Many countries, including those of the EU, have adopted a target to limit the global temperature increase to 2°C above pre-industrial levels. At the G8 Summit in July 2009, the major economies adopted the same target as a guideline for international climate policy. To have a 50% chance of meeting this 2°C target would require stabilization of greenhouse gas concentrations at low levels of 400–450 ppm CO₂-eq (IPCC, 2007).

In order to achieve low stabilization targets, the IPCC indicated that developed countries as a group would need to reduce their emissions within a range of 25–40% below 1990 levels by 2020 (Gupta et al., 2007), as long as emissions in developing countries deviate substantially from their baseline levels (IPCC, 2007, Box 13.7). This was based on a literature review of model studies for various approaches to allocate future reductions to the various regions, such as contraction and convergence, multi-stage and the Brazilian proposal (e.g. historical responsibility; see den Elzen et al., 2005). Each approach makes different assumptions on the global emissions pathway, specific national efforts, equity principles and other variables.

In a recent paper, den Elzen and Höhne (2008), the authors of Box 13.7 in IPCC (2007), elaborated further on the issue of substantial deviation from the (up-to-date) baseline levels by analysing the underlying studies and the literature that became available after the completion of the IPCC report. This paper concluded that, to meet the target of 450 ppm CO₂-eq, these underlying studies required developing countries to reduce emissions by 15–30% below the baseline levels by 2020, and for developed countries the emission reduction would need to be 25–40% below 1990 levels.

Many countries have accepted these findings as input for the climate negotiations for Copenhagen (see, for example, European Council conclusions (2008) and submissions to the AWG KP (Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol) on long-term cooperative action). These reduction ranges, as reported by the IPCC, and the paper by IPCC authors den Elzen and Höhne, have been presented and discussed many times during the climate negotiations before Copenhagen.

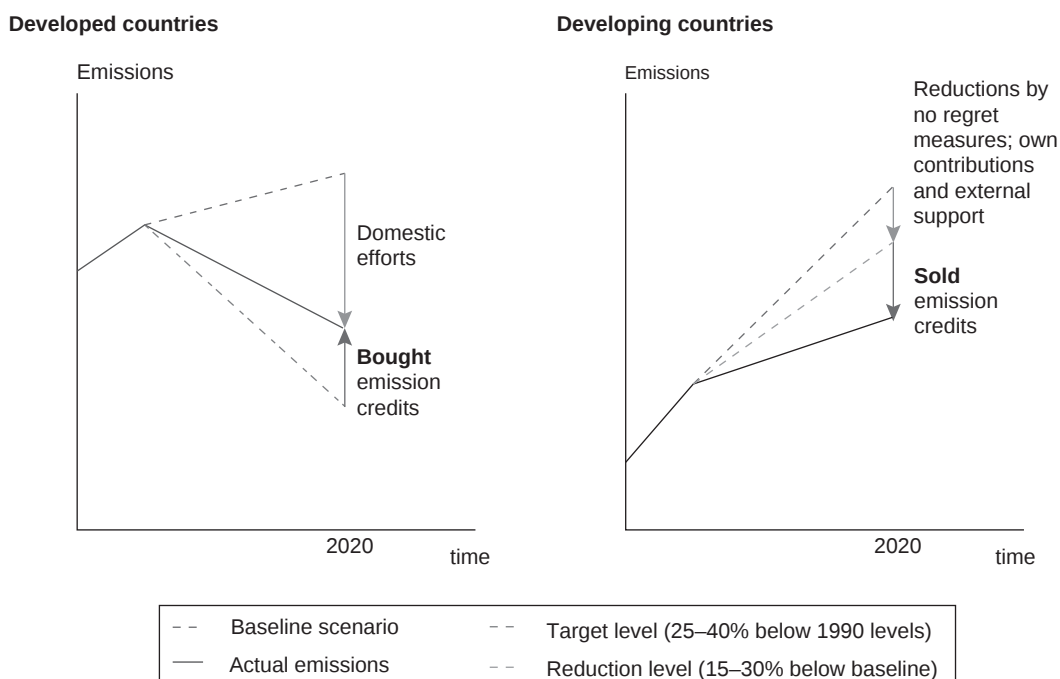
This current article updates and complements our earlier paper by addressing three of the questions which were often raised during these discussions:

1. What part of the reductions can be achieved by the developed and developing countries through either domestic action, use of the Kyoto Mechanisms, or direct financing (Section 2)?
2. Are there any more recently published studies available on emission allocations? How are reduction targets for meeting the 450 ppm level being affected by the assumed global emissions caps for 2020, which vary between 10 and 25% above the 1990 level (Section 3)?
3. What is the impact of reducing CO₂ emissions from Land Use, Land-Use Change and Forestry (LULUCF) (Section 4)?

2. Reduction levels and domestic action by developed and developing countries

Several elements influence the reduction ranges for the developed and developing countries taken from the IPCC (2007) and den Elzen and Höhne (2008). These include offsetting, reducing emissions from deforestation and degradation in developing countries (REDD), and direct financing of mitigation actions in developing countries, as described below.

Offsetting: The ranges are based on post-2012 regimes for allocating regional emission reduction *targets*, that is, *before* the use of the Kyoto mechanism (emissions trading and the Clean Development Mechanism (CDM)). These levels are indicated as dashed lines in Figure 1. Actual emissions from the countries or regions may be different, because of the use of the Kyoto mechanisms. At present, the

Difference between target and actual greenhouse gas emission**FIGURE 1** The reduction levels and actual emissions for developed and developing countries

CDM is the only international climate policy tool that leads to measured, verified and quantified emission reductions in developing countries. However, since Certified Emission Reductions (CERs) from CDM projects are used for developed country compliance ('offsetting'), these do not reduce global total emissions. Figure 1 illustrates this with data on actual emissions (solid lines) that are higher than the 25–40% reductions below 1990 for developed countries – assuming that these countries would buy allowances from developing countries – and actual emissions that are lower than the 15–30% below baseline levels for developing countries – assuming that these countries would sell allowances. Using the Kyoto mechanisms always changes both ranges, never one on its own.

REDD: Slightly different is the use of possible credits from REDD. The studies underlying the ranges in IPCC (2007, Box 13.7) do not explicitly consider emissions from forestry. More reduction effort in this sector would allow less stringent reductions in all other sectors, in order to reach the same global emissions level. If a developed country were to directly finance emission reductions in deforestation in a developing country, this can be attributed to either the developing country's reduction below their baseline levels, or to this developed country's reduction to meet its target (but it cannot be attributed to both).

Direct financing: According to the Bali Action Plan, agreed by the UNFCCC Parties in December 2007, developed countries will support developing countries through additional technology, financing and capacity building to achieve their reduction levels. The reduction efforts of 25–40% below the 1990 level for developed countries, and those of 15–30% below baseline levels for developing countries, do not consider such additional support. If a developed country directly finances reductions in a developing country, this can be counted as a reduction below the baseline level for that developing country.

This all implies that developed countries should be able to achieve their reduction *targets*, in part through domestic action (reductions on their own territory), and in part by using credits resulting from emission reductions in developing countries (offsetting), as illustrated in Figure 1 (left).

Emission reductions of 15–30%, below baseline levels, for developing countries, could be achieved in several ways:

- Through their own financing of mitigation options, including possible emission reduction at negative cost ('no regrets')
- Through direct support from developed countries in the REDD programme and in other measures
- Through carbon trading or other mechanisms, moving the reduction beyond the 15–30% range below their baseline level (Figure 1, right).

In this way, the mitigation in developing countries would be partly financed through their own resources, and partly through multilateral public or international funding. If financing were to be realized through the carbon market, the amount in tonnes would count as a reduction for the developed countries; however, when publicly funded, this would be attributed to the reduction for developing countries.

In conclusion, it can be stated that, for reducing emission levels in developing countries, the developed countries can support them through a mixture of financing, carbon trading and other mechanisms.

3. Reduction levels for developed and developing countries to meet 450 ppm CO₂-eq, based on the assessment of studies

Den Elzen and Höhne (2008) analysed the reductions needed in order for the developed and developing countries to meet concentration levels as low as 450 ppm CO₂-eq, according to ten allocation studies. For the current study we reviewed 19 studies on a 450 ppm pathway. In addition, we also analysed the effect of the assumed global emissions cap in more detail, and divided the studies in two groups: (1) 'lower-range' studies assuming global emissions of 5–15% above 1990 levels, and (2) 'higher-range' studies assuming global emissions of 20–30% above 1990 levels. These levels correspond with meeting a long-term stabilization level of 400 or 450 ppm CO₂-eq. For meeting these long-term low concentration targets, one needs to assume certain overshooting (or peaking); e.g. concentrations may initially increase to an 'overshooting' concentration level, in general of up to about 475 or 500 ppm CO₂-eq (see, e.g., den Elzen and Meinshausen, 2006; Meinshausen et al., 2006). This overshooting is partially explained by the already substantial present concentration levels and the attempt to avoid drastic sudden reductions in the present emissions pathways, as this may lead to high abatement costs due to, for example, possible premature replacement of existing fossil fuel-based capital stock.

Table 1 updates the overview table in our earlier publication (see table 2 in den Elzen and Höhne, 2008) of various allocation studies for the concentration level of 450 ppm CO₂-eq. To be able to show a broader range, we contacted all the authors of new studies in the developing and developed world in a request to send in their reports.

In this study, we included the study by Bode (2004), not included earlier, which calculated the emission reductions for an *accumulated* per-capita emission convergence approach. We also included eight new studies that became available after the finalization of the study by den Elzen and Höhne (2008), marked with an asterisk in Table 1. These studies also used different approaches to allocate regional reductions, varying from approaches based on historical responsibility (study of

TABLE 1 The allocation studies quoted by the IPCC and by more recent studies (in chronological order) aiming at 450 ppm CO₂-equivalent. New studies indicated with an asterisk (*) became available after the study by den Elzen and Höhne (2008)

	Allocation calculations	Allocation schemes ^c	Concentration target	Global emission level by 2020 (% above 1990 level)
'Lower-range' studies^a				
Berk and den Elzen (2001)	CO ₂	MS, C&C, HR	450 ppm CO ₂	15
Groenenberg et al. (2004)	CO ₂	TY	450 ppm CO ₂	15
Kuntsi-Reunanen and Luukkanen (2006)*	CO ₂	C&C	400 ppm CO ₂	10
Höhne et al. (2005)	CO ₂ -eq	MS, C&C, EI, TY, Other	400 ppm CO ₂	10
Höhne et al. (2007)	CO ₂ -eq	MS, C&C, EI, TY, Other	400 ppm CO ₂	10
Höhne and Moltmann (2008)*	CO ₂ -eq	MS, C&C, TY, ID	450 ppm CO ₂ -eq	10
Bows and Anderson (2008)*	CO ₂	C&C	450 ppm CO ₂	10 ^d
Baer et al. (2008)	CO ₂	ID	400 ppm CO ₂ -eq	10
Jacoby et al. (2008)*	CO ₂ -eq	Other	450 ppm CO ₂ -eq	0–5
Kanie et al. (2007)*	CO ₂ -eq	Other	450 ppm CO ₂ -eq	15
'Higher-range' studies^b				
WBGU (2003)	CO ₂	C&C	400–450 ppm CO ₂	20
Bode (2004)*	CO ₂	HR	450 ppm CO ₂	25
den Elzen and Meinshausen (2006)	CO ₂ -eq	MS, C&C	400–450 ppm CO ₂ -eq	20–25
den Elzen et al. (2007)	CO ₂ -eq	MS	400–450 ppm CO ₂ -eq	20–25
den Elzen et al. (2008b)	CO ₂ -eq	MS, C&C	450 ppm CO ₂ -eq	20
den Elzen et al. (2008a)	CO ₂ -eq	TY	450 ppm CO ₂ -eq	20
Ekholm et al. (2008)*	CO ₂ -eq	MS, TY	450 ppm CO ₂ -eq	20
Chakravarty et al. (2009)*	CO ₂	ID	350–400 ppm CO ₂	20 ^e
Knopf et al. (2010)*	CO ₂	C&C	400 ppm CO ₂	30 ^f

Notes: ^aAssuming a (temporary) overshoot of about 25 ppm.

^bAssuming a (temporary) overshoot of about 50 ppm.

^cThe abbreviations for the schemes are: MS: multi-Stage approach (countries participate in multiple stages in the regime with different ambition levels per stage); C&C: contraction & convergence (convergence of per-capita emission allowances for all countries under a contracting global emission profile); EI: emission intensity approach (allocation of emission reductions related to improvements in the emission per unit GDP output); HR: historical responsibility (Brazilian Proposal, i.e. reduction targets based on countries' contribution to temperature increase) (den Elzen et al., 2005); TY: Triptych approach (this approach shares emission reductions according to rules for seven sectors applied equally to all countries); ID: approach that takes account of income distributions in a country to estimate how its emissions are distributed among its citizens; Other: others.

^dFor the baseline scenario we took the average of the six IPCC SRES scenarios (see den Elzen and Höhne, 2008).

^eCorresponds with the cases with a global emissions target of 25 GtCO₂ with individual emission reduction targets.

^fThese studies were included, although on the high side, because their CO₂ emission pathway leads to long-term stabilization at 400 ppm CO₂.

TABLE 2 Greenhouse gas emissions (excluding LULUCF CO₂) (left column) and LULUCF CO₂ emissions (right column) for the developed and developing countries as a group, and for the world, for 1990 and 2005 (upper) and 2020 projection (lower)

	Emissions excluding LULUCF CO ₂ (Gt CO ₂ -eq)			LULUCF CO ₂ emissions (Gt CO ₂ -eq)		
	Developed countries	Developing countries	World	Developed countries	Developing countries	World
1990	18.5	12.9	31.4	0.6	4.0	4.6
2005	18.3	25.7	44.0	-0.1	5.1	5.0
2020 Scenario						
IPCC A1 2001	23.6	34.7	57.6	-1.2	4.7	3.5
IPCC A2 2001	23.1	29.8	52.4	-1.0	6.8	5.8
IPCC B1 2001	19.3	28.4	47.2	-1.4	3.6	2.2
IPCC B2 2001	20.5	31.2	51.1	-1.5	6.9	5.4
IPCC A1F 2001	24.1	35.1	58.5	-1.2	4.8	3.6
IPCC A1T 2001	23.0	33.4	55.8	-1.1	4.6	3.5

Source: IMAGE implementation of IPCC SRES 2001 scenarios (IMAGE Team, 2001).

Bode, 2004) and ‘contraction & convergence’ (three new studies), to approaches basing their allocation on income distribution within a country (two new studies, and an earlier one by Baer et al. (2008). Note that Bows and Anderson (2008) described the CCOptions model, that is, a model that correlates CO₂ stabilization levels with global, regional and national carbon reduction targets based on the contraction & convergence approach (see www.gci.org.uk), but they did not present reduction targets. The reduction targets presented in Figure 2 are based on model runs under the default settings. Also remarkable is the wide reduction range compared with the study of Jacoby et al. (2008). This is evidently the result of their selected and very different allocation schemes, varying from identical reductions for developed and developing countries, to allocation of the allowed 2020 emission levels based on population or ability to pay (which leads to surplus emissions for developing countries), or allocation based on full compensation of all mitigation costs for developing countries.

As shown by den Elzen and Höhne (2008), the 50% interval of all reported values across these studies for emission reduction targets for developed countries equals a 25–40% reduction from 1990 levels by 2020. Although any specific reduction target needs to be based on an interpretation of what is fair (possibly based on specifically preferred allocation methods), this range does provide an indication, according to what the literature currently suggests.

Recently, new studies have focused on allocating the reductions according to various approaches for the individual developed countries, assuming a specific aggregated reduction target for developed countries as a group. Den Elzen et al. (2009) used six different allocation approaches based on costs and convergence criteria, assuming aggregated reduction targets for developed countries, of 20 and 30% below 1990 levels. Winkler et al. (2009a) used an allocation approach that accounts for responsibility and capability principles, using a 40% reduction target for developed countries,

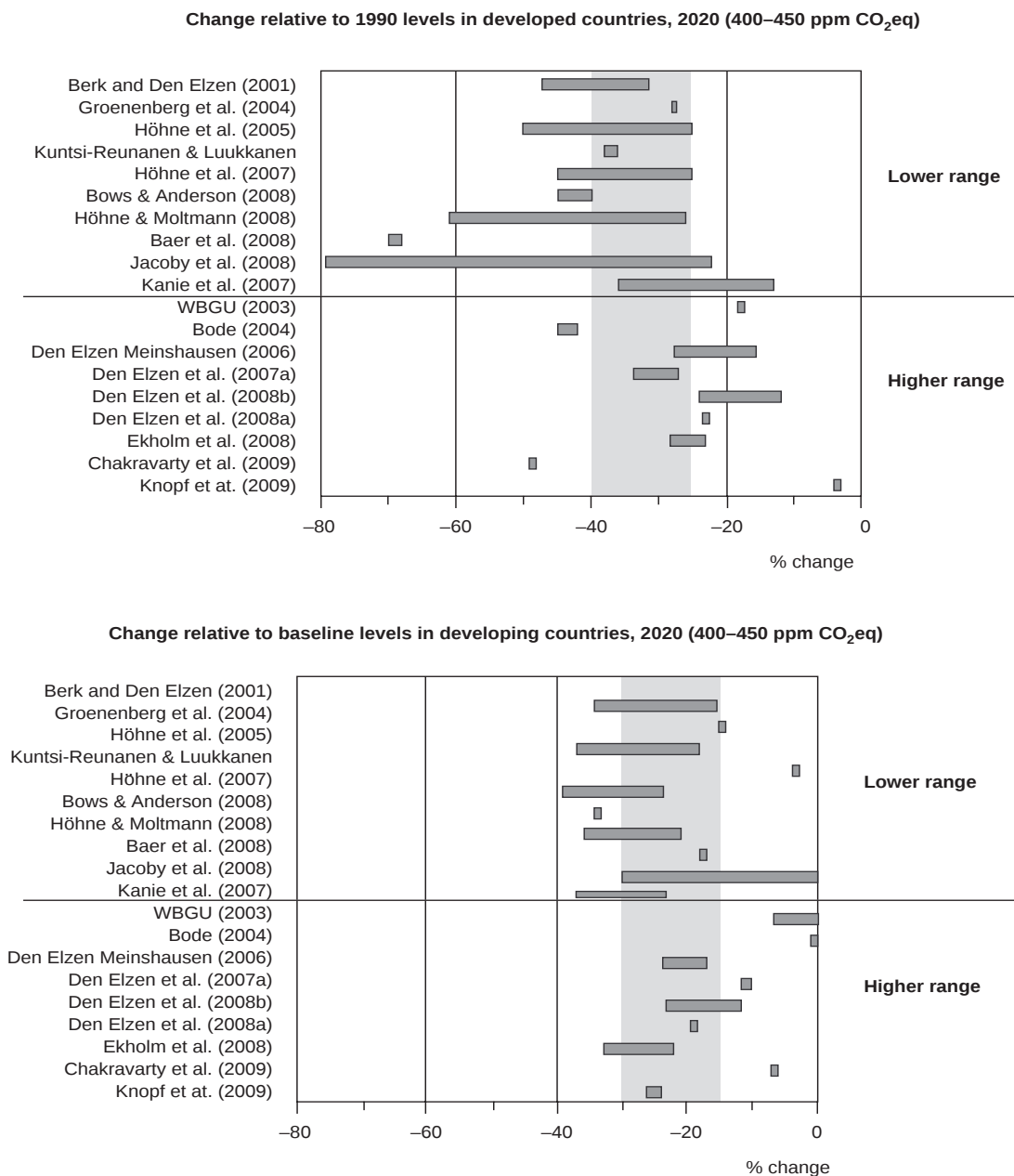


FIGURE 2 Reductions for developed countries as a group (upper), and for developing countries as a group (lower), below baseline emissions, by 2020, aiming at a concentration level of 450 ppm CO₂ equivalent.

Uncertainty ranges indicated here are based on the outcomes of different post-2012 regimes. The figure also depicts the 25–40% reduction ranges for developed countries, as reported in IPCC (2007, Box 13.7), and 15–30% reduction range for developing countries, as reported by den Elzen and Höhne (2008).

which formed the basis of a submission by South Africa. The Philippines used a similar methodology to that of Winkler et al. (2009a), with a different aggregate reduction target, for developed countries, of 50%. The reductions according to the latter two studies were proposed by South Africa and the Philippines in the UNFCCC document FCCC/KP/AWG/2009/7.

Reductions below 1990 levels for developed countries, and below baseline levels for developing countries, are shown in Figure 2. Grouping the 'lower-range' studies of Table 1 on the left of each figure, and the 'higher-range' studies on the right, one can observe the influence of the assumed global emissions cap. The 'lower-range' studies generally lead to more stringent reduction targets than the 'higher-range' studies. Within the 'lower-range' studies, at one extreme is Jacoby et al. (2008), with a very large range, and at other extreme are Baer et al. (2008) and Höhne and Moltmann (2008), which analysed the 'Greenhouse Development Rights' approach that leads to more ambitious reductions for the developed countries than the other approaches. Similarly, for developed countries, 'higher-range' studies lead to reductions in the 25–40% range or less, and for developing countries, to reductions of 15–30% or less, below baseline levels. Two exceptions are the studies by Bode (2004) and Chakravarty et al. (2009).

Figure 3 includes the same reductions for developing countries, but relative to 1990 emission levels. The studies' assumed baseline emission levels for developing countries, for 2020, differ substantially, i.e. between 120% and 180% above 1990 levels, based on a wide range of scenarios, including the IPCC SRES scenarios. Other studies assume an emissions increase of only 60–100% above 1990 levels. These studies use particular baseline levels (e.g. only the B2 scenario). One study uses very high baseline levels of 220% above the 1990 level. A confined overall range for allocation approaches is between 70% (around the 2006 level) to 120% above the 1990 level, by 2020.

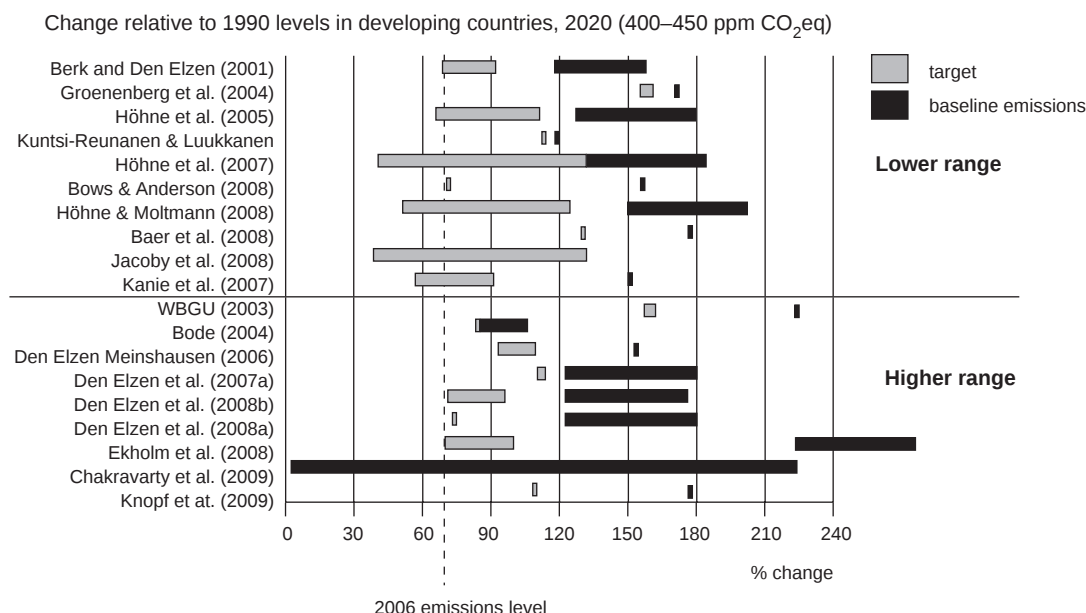


FIGURE 3 Change compared to 1990 levels for the allocation schemes and the baseline emissions, as assumed in the allocation studies in Table 1, for the developing countries as a group, aiming at 450 ppm CO₂ equivalent by 2020. For comparison, the 2006 emission level is also indicated here (vertical dotted line).

The 'higher-range' studies use global technically feasible emission pathways, developed with integrated assessment models, including energy system models, which account for mitigation potential and costs and inertia of the energy system. Therefore, they cannot reduce their emissions very rapidly in the first 10 years, and thus have higher short-term emissions. The 'lower-range' studies simply assume global emissions caps, not taking into account limits to the rate of reduction caused by inertia in the energy system. It is questionable whether global emissions of only 10% above 1990 levels could be met by 2020, given that the 2005 greenhouse gas emissions were almost 25% above 1990 levels, based on EDGAR version 4.0 emissions data (EC-JRC/PBL, 2009). Also, recent scenario studies using integrated assessment models show that in order to achieve the 400 and 450 ppm CO₂-eq targets, global greenhouse gas emissions should peak around 2020, at the latest, at levels of 15–30% above 1990 levels (van Vuuren et al., 2007, 2010; Rao et al., 2008).

Another difference between these studies can be found in the assumptions on the starting point for calculations of reduction targets for developed countries for 2020, varying from the Kyoto target for 2010, or baseline levels for 2010. The 'lower-range' studies generally assume all developed countries to start from the minimum of the Kyoto target or the baseline level for 2010, whereas the 'higher-range' studies generally assume them to start from the Kyoto targets, except for the USA, which starts at its baseline level.

In conclusion, the original ranges of 25–40% reduction by 2020 for developed countries, and 15–30% reduction below baseline levels for developing countries, are all still within the middle ranges in all studies, but do not cover the full range. The 'lower-range' studies generally lead to more stringent reduction targets than the 'higher-range' studies, as summarized in Figure 2 (based on Figure 1 in den Elzen and Höhne, 2008). The full range from all studies, for developed countries, is 5–80% below 1990 levels by 2020, and for developing countries it is either 0–40% below baseline levels or 35–170% above 1990 levels.

A study by Winkler et al. (2009b)¹ showed high reduction efforts for the developed countries by assuming a global emissions increase of 10% above 1900 levels by 2020, being included in the 'lower range'. Winkler et al. (2009b) considered scenarios in which developing countries reduce 10% using their own resources, and another 10% using multilateral public funding, if developed countries reduce emissions by 69% and 52% from 1990 levels by 2020. These reductions are beyond the range of 25–40%, and only the studies based on income distribution (Baer et al., 2008; Höhne and Moltmann, 2008) and on immediate per-capita convergence (Jacoby et al., 2008) showed similar reductions for developed countries.

4. Impact of additional efforts to reduce emissions from deforestation

In the previous section, the reduction levels for the developed and developing countries were shown, as calculated in the different allocation studies, for achieving a concentration level of 450 ppm CO₂-eq or lower. A critical assumption in these studies is the division of efforts between countries according to certain effort-sharing rules. To focus on this important assumption, the second part of the analysis by den Elzen and Höhne (2008) used one model and showed the reductions for developed and developing countries as a function of each other. They analysed how important factors, such as baseline levels and global emissions caps, affect the required emission reduction levels for the developed and developing countries, without prescribing the sharing of efforts.

For this article, two important aspects were added to our earlier work; aspects that were mentioned in the discussions with policy makers:

- In the calculations, we have shown the effect of a combination of different global emissions caps (those of 15% and 25% above 1990 levels), and mitigation scenarios for CO₂ emissions from LULUCF (baseline level versus 50% reduction from this level). The studies cited in Table 1 did not include emissions from LULUCF. How would reduction ranges change if a 50% reduction in baseline CO₂ emissions from LULUCF were included?
- We also calculated the required reduction levels for developing countries, compared with 1990 levels, similar to the reduction targets for the developed countries. The relative reductions for developing countries were defined as reductions below their baseline levels (without climate policy), but the latter is always hypothetical. The substantial uncertainty around this baseline level has to be taken into account.

In this section, these issues are presented, using the same methodology and data that were used by den Elzen and Höhne (2008), which is briefly explained below. We started from a total global emissions cap for 2020 of 15% and 25% above 1990 levels, representing the lower and higher range (400 and 450 ppm).

The calculations were carried out as follows. First, for each of the six IMAGE IPCC SRES scenarios (IMAGE Team, 2001)² (A1B, A1FI, A1T, A2, B1 and B2) the emissions for the developing countries were calculated as the change from their baseline emission levels (Table 2), varying from 0 to -30%. Second, the emissions for the developed countries were calculated as the global emissions cap minus the emissions from the developing countries.³ Finally, the average over separate calculations for each of the six IMAGE IPCC SRES scenarios is presented in Figure 4 and Table 3. For example, in order to meet a 450 ppm CO₂-eq stabilization and, for instance, assuming the emissions from developing countries at 15% below baseline levels, the emissions from the developed countries would have to be 35% and 52% below 1990 levels, for the 25 and 15% global emissions cap, respectively.

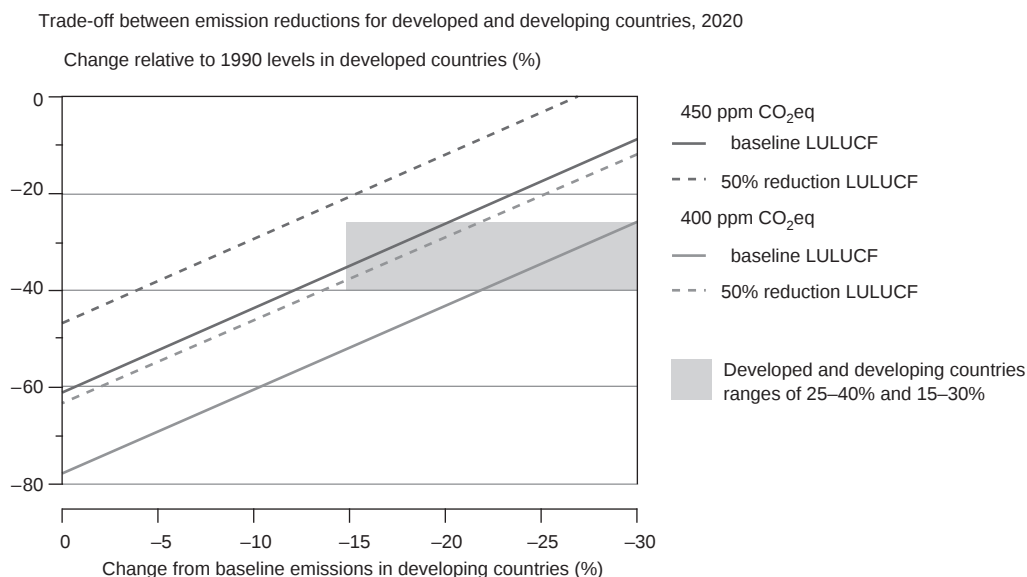


FIGURE 4 The impact of a 50% reduction in LULUCF CO₂ emissions on the trade-off in reductions by 2020, in developed and developing countries as a group, for global emissions 25 and 15% above 1990 levels, leading to 450 and 400 ppm CO₂-eq, respectively. The reduction ranges as reported by the IPCC and den Elzen and Höhne are also shown.

TABLE 3 The trade-off in reductions (excluding and including LULUCF CO₂ emissions) by 2020, in developed and developing countries as a group (as calculated from Figure 4)

	Baseline LULUCF CO ₂ emissions						50% reduction of baseline LULUCF CO ₂ emissions					
	25			15			25			15		
Global emissions % above 1990												
% reduction below 1990 levels in developed countries	25	40	60	25	40	60	25	40	60	25	40	60
% reduction below baseline emission levels in developing countries	21	12	0	30	22	10	12	4	–8	22	14	2
% emissions above 1990 levels in developing countries	97	119	148	73	94	123	118	139	168	93	115	144

New – since the earlier analysis – is the combining of different global emissions caps and mitigation scenarios for REDD of 50% below baseline levels for developing countries by 2020. Most of the baseline scenarios in this analysis assume that emissions from LULUCF will decline slightly from 2005 until 2020 (Table 2), whereas the IMAGE IPCC SRES A2 and B2 scenarios show an increasing trend. The average over all deforestation emissions by 2020 over the six IPCC SRES emissions scenarios is very similar to the 2005 emissions level. For a 50% reduction in deforestation emissions, the average over the six IMAGE IPCC SRES scenarios leads to a global emissions cap of 35% below 1990 levels for all greenhouse gas emissions excluding LULUCF CO₂ (including LULUCF CO₂, would lead to a cap of 25% above 1990 levels).⁴

A 50% reduction in deforestation emissions would ease the reduction effort for the developing countries by about 8%, declining from 15% to 7% below baseline levels, at a 35% reduction for the developed countries (450 ppm). If the developed countries were to finance the total reduction in deforestation emissions, this could be allocated to the developing countries, as shown above, or could also be included in their own reduction. This would lower the reduction for the developed countries, from 35% to 20%, assuming the same 15% reduction for the developing countries. This clearly illustrates that additional efforts to reduce emissions from deforestation would have a major impact on the size of the reductions required in all other sectors for meeting ambitious climate targets.

5. Conclusions

After consideration of the three questions presented at the beginning of this article, the following conclusions can be drawn.

- For developing countries, reductions of 15–30% below baseline levels could be achieved through contributions from these countries themselves, including using emission reduction potential at negative cost ('no regrets'), and through direct support by developed countries in the REDD programme and in other measures. Carbon trading or other mechanisms would not contribute to achieving this reduction range if the credits were to be counted for developed countries towards meeting their 25–40% reduction targets.

- From the analysis of the new allocation studies, we concluded that the original range of 25–40% reduction by 2020 for developed countries is still in the middle range in all studies, but does not cover the full range. The studies assuming global emissions caps, for 2020, of 5–15% above 1990 levels generally lead to more stringent reduction targets than those that assume global caps of 20–30%. For developing countries the reduction range of 15–30% below baseline levels by 2020 corresponds to an increase level from 70% (about the 2006 level) and 120%.
- Reducing deforestation emissions by 50% below baseline levels by 2020 might relax the emission reductions for either group of countries; for developing countries by about 7%, or for developed countries by about 15% (but not for both).

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Notes

1. This study did not analyse a specific allocation scheme for both developed and developing countries and was therefore not included in Figures 2 and 3. Winkler et al. (2009b) used the same simple calculations as den Elzen and Höhne (2008), and these calculations were also used in this study (see Section 4).
2. The IMAGE IPCC SRES scenarios were used here, as they are used by many of the allocation studies in Table 1, for reasons of consistency (one single model is used for every scenario), also providing regional detailed information.
3. This could also be done by first calculating the emissions from developed countries and then calculating the emissions from developing countries, equalling the difference between the global emissions cap and the emissions from the developed countries. The outcomes would be exactly the same.
4. These results are close to those in the case of a phase-out of all global LULUCF CO₂ emissions by 2020 in our earlier study, because a 50% reduction in all LULUCF CO₂ by 2020 for developing countries, combined with negative LULUCF CO₂ emissions for developed countries, corresponds to an 80–90% reduction in global emissions.

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